Repair instructions

MIKRO 22 / 22 R

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AR025GB

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Abbreviations

CP	Control panel
FC	Frequency converter
SB	Supply board
CB	Cooling board
CC	Control cable
LL	Lid locking
BC	Braking chopper
BR	Brake resistor
MR	Mains reset
	Mains switch OFF - ON
EC	Error cause
ES	Error consequence
ER	Error remedy
M	Measurement
ECR	Error-code reset

1. Introduction

- This repair instruction is only intended for specialized staff authorized by HETTICH.

> ⚠ Interventions and modifications at centrifuges, which have been conducted by persons not authorized by HETTICH, are at their own risk and entail the loss off all guarantee and liability claims. In such an event any guarantee claim or liability claim against the HETTICH expire.

- The aim of these repair instructions is to enable any errors to be located and eliminated quickly.

> ⚠ There should be no interventions at, or replacement of components on the individual electronics boards. Experience shows that if an intervention is not performed in accordance with regulations, or if a component is installed whose specification is not identical to that of the original component, then the error (defect) which has occurred will be compounded by further damage. In such an event any guarantee claim or liability claim against the HETTICH ceases to exist.
> Any electronics boards which are not repaired in accordance with the regulations cannot be acknowledged as being replacement spare parts.

- Information about the operation of the centrifuge please see operating instructions.
- We reserve all rights for these technical documents.
- Technical alterations reserved.

2. Description of the new Hettich centrifuges

2.1. Functional structure of the Mikro 22 / 22 R

These microprocessor-controlled centrifuges are comprised of the following electrical components:

- Control panel (CP), microprocessor-controlled
- Supply board (SB)
- Frequency converter (FC, motor control), microprocessor-controlled
- Motor with speed sensor (speedometer)
- Braking chopper (BC) with brake resistor (BR)
- Lid locking (LL)
- Cooling board (CB), only Mikro 22 R

2.2. Control panel (CP)

The CP is the ”brain” or ”master” of the centrifuge.
Via a serial data bus system, the MASTER controls its SLAVE, the component:

- frequency converter (FC)

The individual tasks of the CP are:

- Management of operator inputs and control of LCD display
- Storage of 3 run programs
- Control of components:
  - FC via the enabling circuit and via the serial interface
  - cooling and fan
- Evaluation of the speed sensor (speedometer)
- Evaluation of the imbalance switch.
- Evaluation of the FC fault alarm circuit
- Evaluation of the LL open/closed signalling circuit
- Control of the relay for the LL solenoid at rotor standstill
- Temperature measurement and sensor evaluation of the temperature sensor in centrifuge chamber (only refrigerated centrifuge).
- Routine for input, storage and transfer of temperature offset values
- Format of the serial interface:
  5 Volt interface with 3 conductors
  (16-pole control cable, pole 6, 8 and 11)
- The CP is powered from the SB via the control cable:
  + 10...15 Volt pole 1,2
  GND pole 15,16

2.3. Supply board (SB) A1

The SB performs the following individual functions:

- 12 V DC and 5 V DC supply for the SB.
- 12 V DC supply for the CP.
- 12 V DC supply for the CB (only Mikro 22 R).
- Plugging station X5 for mains power supply, LL magnet and transmission of the signalling circuit for LL switch (open/closed over opto-coupler to the CP).
- Power supply for speed sensor (speedometer).
- Plugging station X4 for speed sensor cable and transmission to the CP and FC.
- Control of the relay for the LL solenoid at rotor standstill
- Plugging station X3 for the imbalance switch and direct transmission of the imbalance signal to the CP.
- The 5 Volt interface with 3 conductors is converted to an RS 485 interface with 2 conductors:
  Interface to FC: RS 485-interface via 2 conductors -
- Transfer of primary enabling (=Hardware STOP) CP ⇒ FC
- Transfer of fault circuit (=FC-ERROR) FC ⇒ CP

2.4. Frequency converter (FC) A2

The FC performs the following individual functions:

- Generation of the motor power supply
  (3-phase AC current of variable frequency and voltage)
  Mode of operation: The mains supply is rectified, smoothed and chopped in three bridge elements to give a pulse-duration modulated supply.
- Monitoring of the motor current
- Evaluation of the overtemperature switch in the motor (only version 115V, AC)
- Slave behaviour (handling of interrogations and commands from the CP via the serial interface):
  RS 485-interface with 2 conductors
  (10-pole control cable, pole 3 and 5)
- Evaluation of the primary enabling (=Hardware STOP) for the FC
  (10-pole control cable, pole 7)
- Evaluation of potential faults and monitoring of the fault circuit (=FC-Error)
  (10-pole control cable, pole 4)
- The electrical power, which resulted from braking, will be conducted to the BR. The braking chopper switches at a voltage:
  - from approximately 390V (230V series)
  - from approximately 200V (115V series)
- The BR is protected by an overtemperature switch. At a short circuit on the BC, which is located on the FC, the BR overheats because of high current. The overtemperature switch cuts off the voltage supply from the FC. After cooling down at the BR the voltage supply is switched on again.

- The CP issues the following via the serial interface:
  - Speed
  - Starting and braking levels
  - Control commands START, BRAKE, STOP
- State display by LED´s:

In standby mode	the green LED is on
In running mode	the green LED is on
In fault mode	the green LED flashes

If the FC processor detects a fault, it shuts down itself automatically and triggers the fault circuit (FC-ERROR). The CP then interrogates the type of fault via the serial interface.

2.5. Special features

- Multiprocessor concept:

  Although one microprocessor will fail, the other one will continue to monitor its assigned area.
  If the CP fails, the drive will be shut down automatically by the FC when no interrogations have been received via the interface for more than 30 seconds.
- Interface concept:

  Transmission of data is monitored by an extra check sum.
- Hardware concept:

  All switches with a safety relevant function are of the NC-contact type, which means that loose contacts and open-circuit faults can also be detected.

2.6. Motor / Tacho system

- The motor is a 3 phase asynchronous motor with 2 pairs of poles.
- A speed sensor (speedometer) attached to the motor receives the following from the transmitter attached to the rotor,
  - rotor code information (see section 10) and
  - speed data (6 pulses per revolution)
- The ACTUAL speed is monitored and controlled via the CP
  - Double safety: The FC is also programmed that no value of speed in excess of the maximum permitted rotor speed can be selected. The FC monitors the speed and switches off at excess speed with error code “ERROR 84”.
- Rotor standstill is monitored via the CP.
  - The lid can only be opened when the CP has detected standstill.

2.7. Imbalance switch

- A switch detects any imbalance.
- Imbalance can only be detected in running mode (starting, centrifuging and braking).
- If any imbalance is detected, the drive is changed over to braking.

2.8. Interlocking

- Opening of the LL is prevented by a latch. The LL can only be opened when the relay on the SB is energized by the CP. This occurs when the rotor is at standstill and mains power is applied. A solenoid is energized and releases the latch.
- The centrifuge can only be started when the lid is closed. A microswitch on the LL detects the position of the LL.

2.9. Cooling

- **Temperature behaviour:**
  - When rotor is at standstill and the lid is locked, the cooling is operating.
  - When rotor is at standstill and the lid is unlocked, there is no cooling.

2.9.1. Temperature sensor B1 in the centrifuge chamber

- This temperature is processed in the CP.
- The housing of the temperature sensor B1 also contains an overtemperature switch. In refrigerated centrifuges this switch cuts off the drive at > 60°C.

2.9.2. Function of the cooling board (CB) A3

- Plugging station (X3) for the temperature sensor and the overtemperature switch in the centrifuge chamber.
- The voltage of the temperature sensor in the centrifuge chamber plug X4 being transmitted over a 10-pole CC to the CP plug X101.
- The signal of the overtemperature switch in the centrifuge chamber plug X4 being onward transmitted over a 10-pole CC to the CP plug X101.
- Plugging station (X2) for the overheating protection B2 at the condenser.
- Relay circuit for the compressor and the fan. The overheating protection B2 at the condenser is series connected to the relay voltage.
- Plugging station (X1) for the compressor and the fan.

2.10. Fan

- The fan cools down the refrigerant flowing through the condenser.
- The fan is parallel-connected to the compressor.

2.11. Offset calibration

- Offset calibration is performed in order to equalize the tolerances of the temperature sensor and the electronics.

Perform Offset calibration when replacing:	Where/How
– the temperature sensor	calibrate the temperature sensor.
– the CP	calibrate temperature sensor and read out the old offset values and put them in the new CP.
– the CP-EPROM	Read out the old offset values and put them in the new CP.

2.12. Protection

Mains power input	⇒	Mains input with overvoltage protection.
Mains switch	⇒	Thermal overload protection (fuse).
FC	⇒	Electronic protection.
Motor	⇒	Overtemperature cutout > 135°C (only 115V version).
Cooling	⇒	Overtemperature switch in centrifuge chamber and at condenser.

3. Requirements for error identification

3.1. Correct power supply

- All fuses of house installation are intact.

Mains voltage is present on the following circuits:

- Cable leading to mains cable
- Appliance plug
- Mains switch
- Radio interference suppression filter
- Supply board A1 (SB), plug X5, (PIN 1 and PIN 5)

3.2. Functional check

- Mains switch is ON.
- All LED`s on control panel must light up.
- The centrifuge type and the software version number appears in the display.
- After about 8 sec. the display switches over to
  - the most recently used centrifuging data or
  - the error code.

3.3. Procedure for diagnosing errors

- Look for the displayed error code in the chapter 4 "Error messages".
- Remedy the error according to the instructions.
- Carry out a functional check after every repair and whenever a component is replaced.
- The technical data which were determined during the final check can be found in the chapter 7 "Functional check".

4. Error messages

4.1. Brief description

- Error messages in: MIKRO 22
  MIKRO 22 R

Error designation	No.	Brief description	Page
TACHO-ERROR	01	Speedometer pulses break down during rotation	15
TACHO-ERROR	02	No speedometer pulses after start command	15
IMBALANCE		Imbalance on motor axle	16
CONTROL-ERROR	04	LL error, lid opened without recognizing that motor had stopped	16
N > MAX	05	Excessive speed error, 250 RPM above n-max of rotor	16
ROTORCODE	10	Invalid rotor code	17
MAINS INTERRUPT		Mains interruption	17
VERSION-ERROR	12	Error in initialisation	17
N < MIN	13	Speed error, slippage is too great	18
CONTROL-ERROR	21	CP - error: speed	18
CONTROL-ERROR	22	CP - error: I²C bus	18
CONTROL-ERROR	23	CP - error: display memory	18
CONTROL-ERROR	24	CP - error: clock timeout	18
CONTROL-ERROR	25	CP - error: EEPROM	18
CONTROL-ERROR	26	CP - error: driver defective	18
N > ROTOR-MAX	---	CP - error: nominal speed is higher than permitted rotor speed or nominal RCF is higher than permitted rotor RCF	18
SER I/O-ERROR	30	No connection between CP and serial interface	18
SER I/O-ERROR	31	No connection between FC and serial interface	18
SER I/O-ERROR	33	Subassembly data incorrectly transmitted	19
SER I/O-ERROR	34	Data incorrectly transmitted between CP and FC	19
SER I/O-ERROR	36	No acknowledgement (NAK) from FC to CP	19

Error designation	No.	Brief description		Page
No cooling (No error displayed)		Overtemperature at condenser		19
°C / *-ERROR	52	Overtemperature in centrifuge chamber		20
°C / *-ERROR	53	Temperature sensor in centrifuge chamber is defective		20
FU/CCI-ERROR	60	Faulty release signal to FC		20
FU/CCI-ERROR	61	FC - error:	computing section	21
FU/CCI-ERROR	62	FC - error:	undervoltage	21
FU/CCI-ERROR	63	FC - error:	overcurrent	21
FU/CCI-ERROR	64	FC - error:	overvoltage	21
FU/CCI-ERROR	67	FC - error:	overtemperature in motor (only 115V)	22
FU/CCI-ERROR	68	FC - error:	overtemperature in FC	22
FU/CCI-ERROR	69	FC - error:	EEPROM	22
FU/CCI-ERROR	84	FC - error:	FC recognizes excess speed	22
FU/CCI-ERROR	85	FC - error:	“Watchdog”in FC had Triggered	22

4.2. Description and elimination of errors

TACHO - ERROR 01

EC During centrifugation the speedometer pulses are interrupted.

ES The rotor slows down until it stops.
After the rotor stops, there is a DC braking for 30 sec.
An MR during slowing-down causes a DC braking for 3 min.
After the DC braking, the ”open the lid” release takes place.
Further cooling to NOMINAL temperature.

ER
- Speed sensor (speedometer) defective or loose contact on plug.
  Measure speedometer pulses on plug X4 / SB, (pin 4 - pin 2).
- CC to CP, or CC to FC is defective.
- SB or CP or FC is defective.

M Also see at SB-X4, CP-X1 (PIN 14 and FC-S501 (PIN 8).

ECR Open the lid. Turn the rotor by hand and perform an MR while the rotor is turning.

TACHO - ERROR 02

EC There are no speedometer pulses on the CP after startup.

ES The rotor slows down until it stops.
After the rotor stops, there is a DC braking for 30 sec.
An MR during slowing-down causes a DC braking for 3 min.
After the DC braking, the ”open the lid” release takes place.
Further cooling to NOMINAL temperature.

ER
- Startup took place without the rotor.
- Motor not connected.
- Motor is defective.
- Speed sensor (speedometer) defective, or loose contact on plug.
  Measure speedometer pulses on plug X4 / SB, (pin 4 - pin 2).
- CC to CP, or CC to FC is defective.
- No release signal to FC.
- SB or CP or FC is defective.

M Also see at SB-X4, CP-X1 (PIN 14 and FC-S501 PIN 8).

ECR Open the lid. Turn the rotor by hand and perform an MR while the rotor is turning.

IMBALANCE

EC Imbalance on motor axle.

ES The centrifuge slows down until the “open the lid” release occurs.
Further cooling until NOMINAL temperature is reached.

ER
- Weight difference in rotor components.
- Supporting lugs not lubricated.
- False IMBALANCE MODE is set (see chapter "Imbalance Mode").
- Imbalance switch not connected.
- Imbalance switch is defective.
- Loose contact in cable or plug.
- CC to CP is defective.
- CP or SB is defective.

M Also see at SB-X3 and CP-X1 (PIN 12)

ECR Perform an MR.

CONTROL - ERROR 04

EC LL is open during centrifugation.

ES Slowing down until the ”open the lid” release occurs.
Further cooling until NOMINAL temperature is reached.

ER
- LL is defective and can be opened during centrifugation.
- Loose contact in cable or in plug.
- CC to CP is defective.
- CP or SB is defective.

M Also see at SB-X5 (PIN 2 and PIN 6) and CP-X1 (PIN 5).

ECR Perform an MR.

N > MAX 05

EC Excess speed. The speed recognized by the speed sensor (speedometer) is 250 RPM greater than the n-max speed of the rotor.

ES The centrifuge slows down until the ”open the lid” release occurs.
Further cooling until NOMINAL temperature is reached.

ER
- Insulation of speed sensor (speedometer) cable is defective.
- Loose contact on speed sensor (speedometer) cable.
- Speed sensor (speedometer) is defective.
- CC to CP is defective.
- CP or FC or SB is defective.

ECR Perform an MR.

ROTORCODE 10

EC An invalid rotor code was read during startup.

ES The centrifuge slows down until the ”open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- Magnetic coding on rotor is defective.
- Speedometer system is defective.
- Loose contact on speed sensor (speedometer) plug
- The rotation of the rotor (direction) is incorrect.

M See at section 10.

ECR Open the lid or perform an MR.

MAINS INTERRUPT

EC Interruption of mains supply during centrifugation.

ES The centrifuge slows down until the ”open the lid” release occurs.
- Switching on at the mains during centrifugation causes slowing-down until the ”open the lid” release occurs.
- Switching on at the mains when the rotor has stopped brings about the ”open the lid” release.

ER
- Power supply has failed.
- Loose contact in electrical connections.
- CC to CP is defective.

ECR Open the lid and press the START key.

This error **cannot** be reset by an MR

VERSION - ERROR 12

EC Differences in the initialisation from CP (EPROM) or FC.

ES No further user operation is possible.

ER
- An incorrect EPROM has been plugged into CP.

M Also see initialisation section 5.2.

ECR Perform an MR.

N < MIN 13

EC Insufficient speed; the slippage of the motor is too great.
The centrifuge regulation can adjust the speed by 5% max. (the limit of adjustment).
The error is indicated if the ACTUAL speed is lower than the NOMINAL speed minus 5%.

ES The centrifuge slows down until the ”open the lid” release occurs.
Further cooling until NOMINAL temperature is reached

ER
- Motor is labouring (damage to bearings).
- Motor has a short-circuited coil (coil is defective).
- Loose contact in the electrical connections.
- FC is defective.
  Release signal to FC was interrupted during centrifugation.

ECR Open the LL.
Perform an MR.

CONTROL - ERROR 21 - 26

EC Internal error in CP.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- CP is defective.

ECR Perform an MR.

N > ROTOR-MAX

EC Error in the entered program

ES Further operation is not possible.

ER SET speed or SET RCF is higher than the permissible rotor speed or permissible rotor RCF.

ECR Carry out a MAINS RESET or open the lid.
Reduce the speed or RCF in the entered program to the permissible rotor speed or permissible rotor RCF.

SER I/O - ERROR 30 and ERROR 31

EC CP has no connection to the component FC via serial interface.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- CC to FC is defective.
- There is no voltage on FC.
- F2 overtemperature switch on brake resistor has opened or is not connected.
- CP or FC is defective.
- Cable on plug S102 is not or wrong plugged

ECR Perform an MR.

SER I/O - ERROR 33

EC CP is not receiving correct data from FC.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- CC to FC is defective.
- CP or FC is defective.

ECR Perform an MR.

SER I/O - ERROR 34

EC CP is not receiving correct data from FC.

ES The centrifuge slows down until the ”open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- CC to FC is defective.
- CP or FC is defective.

ECR Perform an MR.

SER I/O - ERROR 36

EC FC sends signal NAK to the CP after receiving an unknown command. NAK (not acknowledged).

ES The centrifuge slows down until the ”open the lid” release occurs. Further cooling until NOMINAL temperature is reached.

ER
- CC to FC is defective.
- FC is defective.
- CP is defective.

ECR Perform an MR.

NO COOLING

EC No cooling in centrifuge chamber. Overtemperature at condenser, temperature > 60°C.

ES Cooling switches off. Continuance of centrifugation until temperature switch in the centrifuge chamber triggers and “ERROR 52” appears. The centrifuge slows down until the “open the lid” release occurs.

ER
- Condenser soiled.
- Loose contact in plug.
- SB is defective.
- Fan is defective.
- Sensor cable B2 is defective.

M Also see at CB-X2.

ECR Perform an MR.

°C / * - ERROR 52

EC Overtemperature in centrifuge chamber.

ES The centrifuge slows down until the ”open the lid” release occurs.

ER
- Sensor cable B1 is defective.
- Loose contact in plug.
- CP is defective.
- CB is defective.

M Also see CB-X3 (PIN 1 and PIN 2) and CP-X101 (PIN 4).

ECR Perform an MR.

°C / * - ERROR 53

EC Temperature sensor in centrifuge chamber has a short circuit or a discontinuity.

ES The centrifuge slows down until the ”open the lid” release occurs.
Cooling switches off.

ER
- Temperature sensor is defective.
- Sensor cable B1 is defective.
- Loose contact in plug.
- CP is defective.
- CB is defective.

M Also see at CB X3 (PIN 5 and PIN 4) and CP-X101 (PIN 8).

ECR Perform an MR.

FU / CCI - ERROR 60

EC The release signal was not correctly transmitted to FC.
The evaluation of the release signal only occurs once after MR.

ES No further user operation is possible.

ER
- CC to FC is defective.
- CC to CP is defective.
- SB is defective.

M Also see at CP-X1 (PIN 4) and FC-S501 (PIN 7).

General Notice for FU / CCI - ERROR 61 to FU / CCI - ERROR 69

ES
- FC switches independently.
- The rotor freewheels, coasting.
- No further user operation is possible.
- Cooling continues until nominal value is attained.

ECR
- Mains switch is OFF.
- Switch mains switch to ON after 1 min.

M Also see at FC-S501 (PIN 4) and CP-X1 (PIN 13).

FU / CCI - ERROR 61

EC Error in computing section.

ER
- CC is defective.
- FC is defective.

FU / CCI - ERROR 62

EC Undervoltage. Mains voltage less than 20% as nominal voltage.

ER
- Supply voltage too low, see chapter "Short the mains choke coil".
- CC is defective.
- FC is defective.

M Also see at FC, $U_{DC.}$

FU / CCI - ERROR 63

EC Overcurrent.

ER
- Short circuit in motor.
- Motor impedance is too low.
- CC is defective.
- FC is defective.

FU / CCI - ERROR 64

EC Voltage in intermediate circuit:
> 410 V DC at 230 V
> 205 V DC at 115 V
This error normally only occurs when the drive is being braked.

ER
- BR is defective.
- CC is defective.
- FC is defective.

M Also see FC, U_{DC}.

FU / CCI - ERROR 67

EC Only centrifuges with 115 V.
Overtemperature in the motor. The cable “overtemperature” in the motor has high impedance.

ER
- Overtemperature switch opens because of overtemperature in the motor
- CC is defective.
- FC is defective.
- Motor is defective

M
- Also see at FC S2.

FU / CCI - ERROR 68

EC Overtemperature in FC.

ER
- Insufficient heat abduction from FC to centrifuge housing. There is no, or not enough, heat-conducting paste between FC and housing.
- Full-load operation and an ambient temperature > 45°C.
- CC is defective.
- FC is defective.

FU / CCI - ERROR 69

EC EEPROM in FC is defective.

ER
- CC is defective.
- FC is defective

FU / CCI - ERROR 84

EC FC recognizes excess speed.
- During rotation the speedometer pulses (6 per revolution) are controlled by the FC.
- The FC switches the centrifuge off, when the maximum speed is exceeded more than 500 rpm.

ER
- CCis defective.
- FC is defective.

M Also see at SB-X4 and FC-S501 (PIN 8).

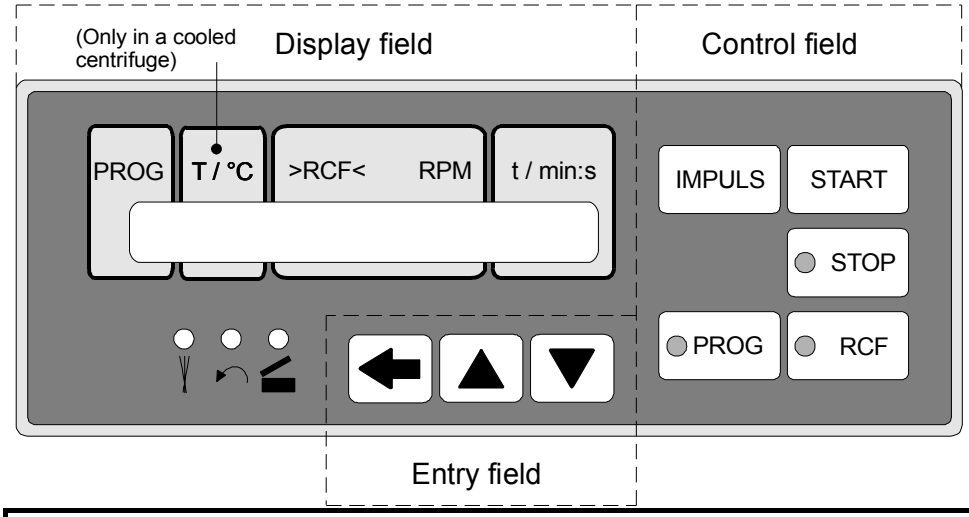
FU / CCI - ERROR 85

EC “Watchdog” in FC
Discrepancy in program procedure

ER
- CCis defective.
- FC is defective.

5. Factory setting

5.1. Control panel



> The EPROM of the CP must, in all circumstances, correspond to the machine version and the cooling version.

5.2. Procedure for initialisation

An initialization must be carried out:

- after replacing the FC.

The frequency converter must be adjusted to the centrifuge.

Requirement:

1. Rotor has stopped.
2. LL is open.
3. Mains switch is OFF.
4. Plug on coding strip X3 on the CP has a jumper in slot 3 and in slot 4 (initialisation position).

- Mains switch is ON → Display: **INIT - MODE**
- Press ⇦ key → Display: **VERS 12 °C / * 01**

machine version

Cooling version (01 = with cooling, 00 = without cooling)

- Press the ◄ key → Display: **IMBALANCE MODE 2**
- Press the ▲ or ▼ key to set IMBALANCE MODE 1 or IMBALANCE MODE 2. Now press the START key to save this setting. Information about IMBALANCE MODE see chapter "Imbalance Mode".
- Press ⇦ key → Display: **PARAM - INIT 0000**

machine version

Number of initialisations

CP : control panel, FC : frequency converter, SB : supply board, CB : cooling board, CC : control cable, LL : lid locking, BC : braking chopper, BR : brake resistor, MR : mains reset, EC : error cause, ES : error consequence, ER : error remedy, M : measurements, ECR : error-code reset

- Press START key → Display: ***** OK *****
  and then: **PARAM - INIT C001**
  ↑ ↑
  machine version
  Number of initialisations

- Mains switch is OFF
- Remove both jumpers from slot 3 and slot 4 on coding strip X3 on the CP.

> ⚠ Put a jumper on slot zero at the plug on coding strip X3 on the CP. (Service position, “Watchdog”)

An initialisation is **always necessary** after a replacement of the FC.

5.3. Imbalance Mode

From programme version 3.00 it is necessary to set the imbalance mode during the initialization.
Depending on the SB version IMBALANCE MODE 1 or IMBALANCE MODE 2 must be selected.

> ⚠ If the incorrect imbalance mode is selected, the display shows error "IMBALANCE" permanently !

5.4. OFFSET alignment

An OFFSET alignment is performed to align the temperature sensor and the CP electronics with one another. An alignment must be performed in any event:

- 1. Replacement of the temperature sensor at the centrifuge chamber.
- 2. Replacement of the CP or the EPROM at the CP.

The OFFSET alignment for the temperature sensor is carried out in the CP.

To carry out an offset compensation, measure the temperature directly on the temperature sensor with a temperature measuring device. Then enter the measured value in the display and save it.

> ⚠ Each correction must be confirmed by the START key.

Requirements:
1. Rotor has stopped.
2. LL is open.
3. Mains switch is OFF.
4. Plug on coding strip X3 at the CP the jumper from slot 0 to slot 3 (OFFSET position).

5.4.1. OFFSET value

The OFFSET value is the difference between the actual temperature and the sensor temperature.

Example:	Actual temperature	-	Sensor temperature	=	OFFSET value
	25.5 °C	-	27.0 °C	=	-1.5 °C

5.4.2. Procedure for performing an OFFSET alignment

1. Mains switch is ON → Display: *** OFFSET - MODE ***
2. Press ⇦ key → Display: T1: 27,0 °C → 25,5 °C

Sensor temperature

Actual temperature

- The sensor temperature measured is to be adjusted with the ▲ ▼ keys to make it agree with the actual temperature.

3. Press the key → Display: ***** OK *****

- If the temperature settings are not confirmed by pressing the START key, the old settings will be maintained.

4. Mains switch is OFF.
5. Remove jumper from slot 3 on coding strip X3 on the CP.

> ⚠ Put the jumper on slot zero at the plug on coding strip X3 on the CP (Service position, “Watchdog”).

5.4.3. Note for temperature sensor in centrifuge chamber

If the temperature in the sample deviates from the nominal value (Display), the offset alignment can be altered as follows:

- Actual temperature is lower than nominal temperature:
  Set the offset temperature of T1 lower by the amount of the deviation (the corrected value is lower).
- Actual temperature is higher than nominal temperature:
  Set the offset temperature of T1 higher by the amount of the deviation.

6. Function retrievals / settings

Requirements: 1. Rotor is stopped.
2. Mains switch is ON

Keep ⇦ key pressed down until (after about 8 sec.) the following appears in the display:

1. **SOUND / BELL ON1** or **OFF** (acoustic signal)

Press ⇦ key. Every time the key is pressed, the display alters as follows:

2. **CONTROL XXXXX h** Hours of operation
3. **VERS XX °C / * XX** Machine version, cooling version
4. **FU / CCI - 1000** FC type
5. **FU / CCI - S. 00.XX** FC software

If nothing more is keyed in for 8 sec., the CP switches over to normal mode. Only Nos. 1. and 2. of the function retrievals listed here can be altered.

6.1. Acoustic signal

After in the display appears:

- **SOUND / BELL ON1** or **SOUND / BELL OFF**

the acoustic signal can be deactivated or activated after standstill using the ▲ ▼ keys.

ON1 Every 30 sec. there is an acoustic acknowledgement that the rotor has stopped. The acknowledgement can be silenced by pressing a key or opening the lid.

OFF The fact that the rotor has stopped is not acknowledged acoustically.

The setting of the acoustic signal must be confirmed by pressing the START key.
In the event of an error, the acoustic signal sounds every 2 sec. until a key is pressed or the lid is opened.

6.2. Hours of operation

After the **CONTROL XXXXX h** appears, the hours of operation can be seen and, after being selected by pressing the ○ RCF key, can be altered using the ▲ ▼ keys.

The ▼ key sets the hours-of-operation indicator to 0.

The ▲ key increases the hours-of-operation display by 1.

To make the number of hours increase quickly, keep the ▲ key pressed down.

The setting of the hours of operation must be confirmed by pressing the START key.

6.3. Slippage of the drive

Requirement: The centrifuge is running at its rated speed.

Permissible slippage: < 5% of the rated speed.

Keep the ⇦ key pressed down until (after about 8 sec.) the following appears in the display:

Actual speed in RPM Rotary frequency in RPM

When the ⇦ key is pressed again, the CP switches to normal mode.

6.4. Setting display contrast on control panel

The display contrast has been preset at the factory, but can be readjusted.

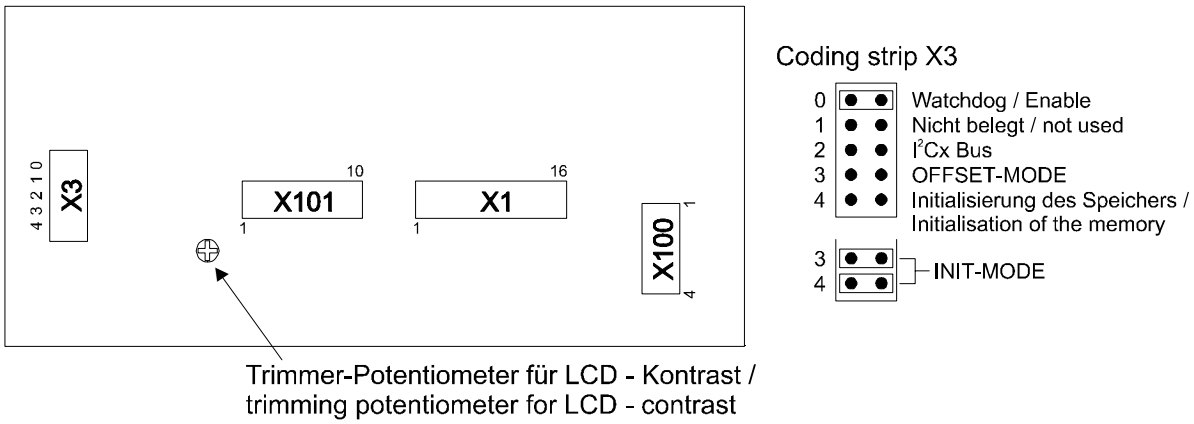
Requirements: The control panel is at room temperature (20 ... 25°C).

The contrast must be adjusted so that the background pixels are not visible.

Adjustment:

Using a screwdriver, adjust the contrast on the trimming potentiometer on the rear side of the control section (see diagram).

Rear side of control panel:



7. Functional check

7.1. Functional check at factory

Following accessories are required to perform the functional check:

- Testing rotor
- Two reaction receptacles filled with water

Table 7 lists measured values, and, ranges of measured values, which have been laid down for these accessories.

In the final check, the functional efficiency of each centrifuge is verified, with the measured values and ranges of measured values being taken into account.

Table 7

Measurements carried out on the centrifuges at the factory				MIKRO 22 MIKRO 22 R
with testing rotor				1153
load: two reaction receptacles				1.5 ml
reaction receptacles filled with				Water
Measuring instruments used in final check				
Temperature measuring instrument		THERM 2250-1		X
Moving-iron current measuring instrument				X
Moving-coil current measuring instrument				X
Rated speed	n_{max}		RPM	14000
Slippage	at n_{max}		RPM	100 – 400
Starting current	up to n_{max}		A	7.0 - 7.7
			A	
Rated current	up to n_{max}		A	2.0 - 2.7
			A	
Total current	with cooling		A	≤ 3.0
			A	
Starting time	Stage 9 up to n_{max}		sec	9 – 13
Rundown time	Stage 9 from n_{max}		sec	14 – 18
Starting time	Stage 5 up to RPM 4000		sec	20 – 25
Rundown time	Stage 5 from RPM 4000		sec	23 – 28
Imbalance	Run through at		g	≤ 2
	Switch off at		g	≥ 7

CP : control panel, FC : frequency converter, SB : supply board, CB : cooling board, CC : control cable, LL : lid locking, BC : braking chopper, BR : brake resistor, MR : mains reset, EC : error cause, ES : error consequence, ER : error remedy, M : measurements, ECR : error-code reset

Temperature measured at room temperature RT			≤26 °C
Sample temperature after 1 h running time			RT + 17 K
Sample temperature in cooled centrifuges after 1 h running time			
1st run	4°C	14000 RPM	+2 °C to +6 °C
2nd run	20°C	n_{max}	+18 °C – 22 °C
3rd run	37°C	n_{max}	+35 °C– 39 °C
Machine temperatures after 2nd run			
Motor:	Unscrew motor covering and measure at stator lamination bundle		RT + 70 K
A bearing:	Measure ball bearing temperature at inner ring		RT + 70 K
FC:	Measure at FC fastening brackets		RT + 20 K

8. Functional test

8.1. Checking the proper working order

By measuring and comparing the data listed under Table 7, it can be determined if a centrifuge is in proper working order. A precondition for this is that the necessary components stated under Table 7 are used for the measurements.
If the measurements are carried out using other components, the numerical values from the ”Rotor and accessories” chapter of the operating instructions for the particular centrifuge must be employed.
If the measured values obtained for:

- the speed,
- the starting and rundown times
- the temperatures in cooled centrifuges,

are identical to the numerical values in Table 7, or to those in the ”Rotor and accessories” section of the operating instructions, then the centrifuge is in proper order.

8.2. Proper working order after repairs

See section headed ”Checking the proper working order”. The following values must be checked in addition:

• Insulation resistance	> 2 MΩ
• Protective conductor resistance	< 0,2 Ω
• Leakage current	< 3,5 mA *
	* limit according to EN 61010

A laboratory centrifuge do not belong to those medical appliances which may be tested according to the regulation IEC 601 or corresponding national medical electronic standards. Laboratory centrifuges are classified as laboratory equipment.
The regulations applying to laboratory equipment are IEC 1010 or European standard EN 61010.

9. Assembling and disassembling components

Before assembling or disassembling components, the working processes in Table 9-B for MIKRO 22 and MIKRO 22 R must first be carried out to reach the components and make a note of the plug numbers.

The components are assembled in reverse order !

The further procedure is described on the following pages.

In Table 9-A the components are ordered in the following sequence:

Column 1: Abbreviation
Column 2: Components
Column 3: Abbreviations in the circuit diagrams
Column 4: Plug connections
Column 5: Connections at the electronic-panels
Column 6: Described in capture.

Table 9-A

1	2	3	4	5	6
A	Speed sensor (speedometer)	B3	X4	A1	9.1
B	Motor	M1	S101	A2	9.2
C	Vibration damper				9.2
D	FC (frequency converter)			A2	9.3
E	EPROM (on FC)			A2	9.3
F	SB (supply board)			A1	9.4
G	CB (cooling board)			A3	9.5
H	CP (control panel)			A4	9.6
I	EPROM (on CP)			A4	9.7
J	Mains choke coil			-	9.12
K	CC (control cables) - 16 conductors		A4-A1		9.8
	- 10 conductors		A1-A2		
	- 10 conductors		A4-A3		
L	LL (lid locking)	Y1	X5	A1	9.9
M	BR (brake resistor)	R1	P10-P1	A2	9.10
N	Radio interference suppression filter	Z1	X5-Q1	A1	9.11
O	Mains switch ON / OFF	Q1	Z1-F1		9.13
P	Appliance plug	B4	F1		9.14
Q	Overvoltage protection	F1	B4-Q1		9.14
R	Imbalance switch	S1	X3	A1	9.15
T	Temperature sensor (centrifuge chamber)	B1	X3	A3	9.16
U	Temperature sensor (condenser)	B2	X2	A3	9.17
V	Fan (compressor)	M3	X1	A3	9.18
W	Compressor	M2	X1	A3	9.19
X	Lid spring				9.20
Y	Hinge block				9.21

Table 9-B

Working processes		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1.	Open lid	X	X	X							X		X						X		X			X	X	X
2.	Set mains switch to OFF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
3.	Disconnect centrifuge from mains voltage	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
4.	Disassemble rotor	X	X	X															X		X					
5.	Remove motor covering in centrifuge chamber	X	X	X															X		X					
6.	Take rubber sleeve under motor covering out		X	X															X		X					
7.	Detach front screen		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
8.	Pull of the control cable from the CP		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
9.	Remove front screen	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
10.	Detach rear covering																					X	X	X	X	X

Example: Disassembling appliance plug

1. Definite the abbreviation of the appliance plug in Table 9-A, column 1. Appliance plug = P
2. See Table 9-B column P and carry out the working processes in numeric order.
3. Definite in Table 9-A the corresponding abbreviation, for the example line P and pick out in column 6 the especially capture (9.13), where the disassembly is described.

9.1. Speed sensor B3 (speedometer)

- Unscrew speed sensor (speedometer) from upper end plate of motor.
- Unplug plug number X4 from Supply board A1.
- Replace speed sensor (speedometer).

9.2. Motor M1 / Vibration damper

- Unscrew speed sensor (speedometer) from upper end plate of motor, and place it in centrifuge chamber.
- Pull out the 3 cables from plug S101 at the FC (BU/BN/BR).
- Use a socket spanner to loosen and remove the three fastening nuts on lower end plate of motor.
- Lift motor upwards out of centrifuge. Unplug the earth lead.
- Before motor is installed, the three vibration dampers must be checked for possible wear or cracks, and if necessary replaced.
- Replace the motor.
- Care must be taken of the anti-twist device when the vibration dampers are being installed.

9.3. FC (frequency converter)

- Pull all plugs out of FC.
- Unscrew the four fastening screws of FC.
- Unscrew the screws on the connecting clips and pull the cables out.
- Replace FC
- Before installation, it must be noted that there is a heat-conducting paste between FC and centrifuge housing floor.

Heat conducting from FC to centrifuge housing floor must be ensured.

9.4. SB (supply board) A1

- All plugs on the SB must be pulled out.
- Unscrew the four screws, and take SB out of centrifuge.
- Replace SB

9.5. CB A3 (cooling board) only MIKRO 22 R

- All plugs on the CB must be pulled out.
- Unplug the two cables (RD and BK) at the SB.
- Unscrew the four fastening screws at the CB.
- Replace the CB.

9.6. CP (control panel) A4

- Detach the two holding frames at the CP.
- Lift out the CP on the opening at the front screen.
- Replace the CP.

9.7. EPROM at CP

- Pull the EPROM carefully out of IC-socket.
- Pay attention to the polarity of the EPROM when installing.
- Do not bend the IC-pins.

Before touching the EPROM ensure that your own static electricity is discharged.

- Replace the EPROM.

9.8. CC (control cables)

- Unplug the corresponding control cable from the boards.
- Replace the control cable.

9.9. LL (Y1) (lid locking)

- Remove the front panel.
- Unplug all cable from the lid lock.
- Loosen the to fastening screws on the to of the housing.
- Exchange the lid lock.

9.10. BR R1 (brake resistor)

- From below loosen the two fastening screws of the BR at the floor.
- Unplug the cables at the BR and the FC.
- Loosen cable at overtemperature switch on the BR (clip S102, position U1).
- Replace BR.

9.11. Radio interference suppression filter Z1

- Unscrew the fastening screws of the radio interference suppression filter.
- Remove the plugs from the radio interference suppression filter.
- Replace the radio interference suppression filter.

9.12. Mains choke coil (L1)

9.12.1. Assembly and disassembly

- Pull both plugs from the mains choke coil.
- Undo the fastening screws of the mains choke coil.
- Replace the mains choke coil.

9.12.2. Short the mains choke coil

> In countries, in which the European standard EN 61000-3-2 applies it is not allowed to short the mains choke coil.
>
> The mains choke coil reduces the mains input current below the limit values stated in the above mentioned European standard.

If the centrifuge is run with undervoltage, that is mains frequency 50 Hz with a voltage < 205 V or mains frequency 60 Hz with a voltage < 210 V the voltage drop of the mains choke coil can cause the error FU / CCI - ERROR 62.
The short of the mains choke coil will increase the supply voltage of the frequency converter.

- Pull both plugs (A) and remove the cable, see Figure 1.
- Pull the plug (B) from the mains choke coil (see Figure 1) and plug it onto the free connector from the radio interference suppression filter (C), see Figure 2.

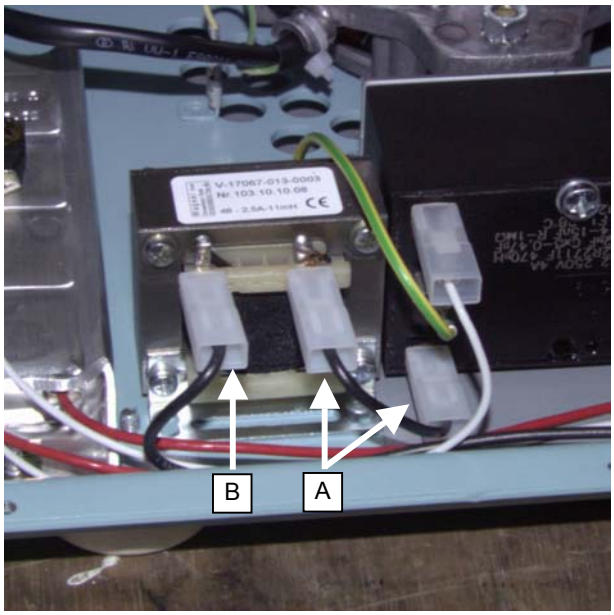


Figure 1

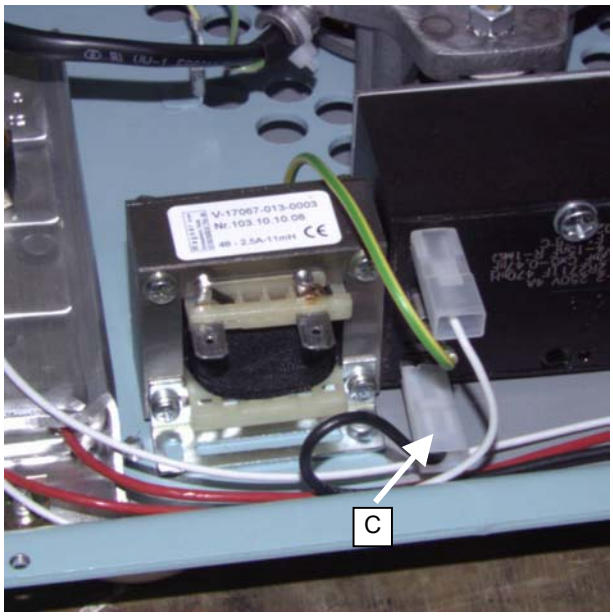


Figure 2

9.13. Mains switch Q1

- Press mains switch out of lower part of housing.
- Remove all plugs at mains switch.
- Replace mains switch.

9.14. Appliance plug B4, overvoltage protection F1

- Remove mains switch, see chapter 9.13.
- Unscrew the two fastening screws at the appliance plug.
- Pull the appliance plug out of the opening.
- Remove the overvoltage protection from the appliance plug.
- Replace appliance plug.
- Unplug the cables at the overvoltage protection.
- Replace overvoltage protection.

9.15. Imbalance switch S1

- Remove plug from position X3 at the SB.
- From below loosen the two fastening screws of the imbalance switch.
- Loosen the fastening nuts from the motor. Lift up the motor and pick up the imbalance switch through the opening at the centrifuge chamber.
- Replace imbalance switch.

9.16. Temperature sensor B1 in centrifuge chamber

- Remove plug from position X3 at the CB.
- Remove the lock with appropiate tools at the front of the plug. Then press out the four bushes.
- Press out the temperature sensor in the centrifuge chamber.
- Replace temperature sensor.

9.17. Temperature sensor B2 at condenser

- Remove upper housing part with lid (four screws).
- Lift up the upper housing part and the lid.
- Unscrew temperature sensor at the mounting (one screw).
- Unplug plug from position X2 at the CB.
- Replace temperature sensor.

9.18. Fan M3

- Remove upper housing part with lid (4 screws).
- Lift up the upper housing part and the lid.
- Detach fan.
- Unplug the two plugs at the fan.
- Replace fan.

9.19. Compressor M2

- Remove upper housing part with lid (4 screws).
- Lift up the upper housing part and the lid.
- Loosen the four hex nuts at the compressor below.
- Loosen the cable at compressor.
- Replace compressor.

9.20. Lid spring

- Open the lid.
- Loosen the fastening screws at the inner side of the lid.
- Pull up the external lid part out of the guideway.
- Replace defective component.

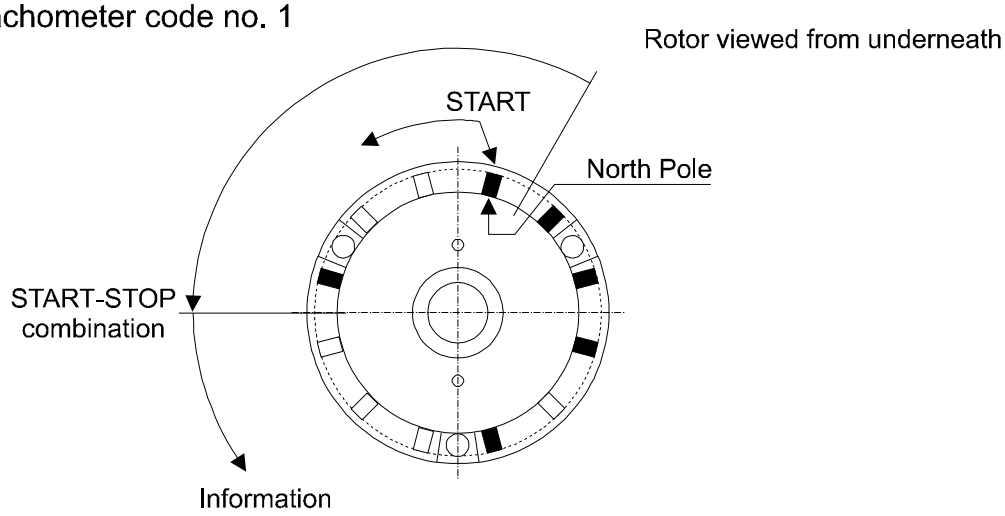
9.21. Hinge block

- Remove upper housing part with lid (4 screws).
- Lift up the upper housing part and the lid.
- Loosen the fastening screws at the inner side of the lid.
- Pull up the external lid part out of the guideway.
- Remove lid spring.
- Unscrew hinge from cover.
- Replace hinge block.

10. Speedometer-code-position of the rotors

MIKRO 22 / 22 R		
Speedo-meter-code-No.	Position occupied	Rotor
0	1001 0000 1111	SK 57.98-1
1	1001 0001 0111	1015, 1016
2	1001 0001 1011	1158
3	1001 0001 1101	1151
4	1001 0001 1110	1159, 1195
5	1001 0100 0111	1154
6	1001 0101 0101	1153, 1189
7	1001 0101 0110	1157
8	1001 0101 1010	
9	1001 0110 0011	
10	1001 0111 0001	E1729
11	1001 1000 0111	1020, 1013
12	1001 1000 1011	1161
13	10011000 1101	1048
14	1001 1010 0011	1023
15	1001 1100 0011	

Example: tachometer code no. 1



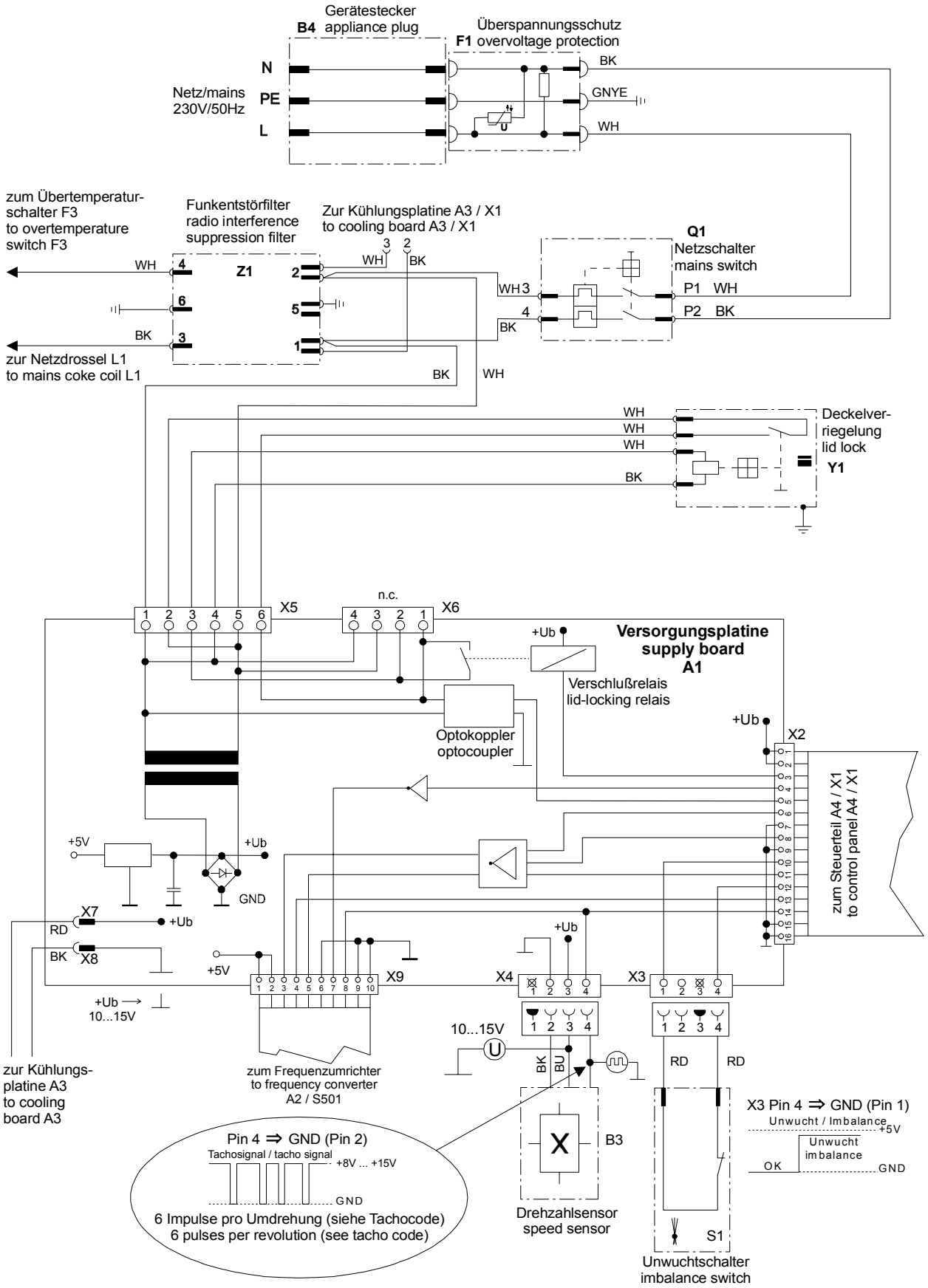
tachometer code determines: 1. maximum speed of rotor
2. run up and braking ramps
3. control response of electronics

Used cable colours and their short codes:

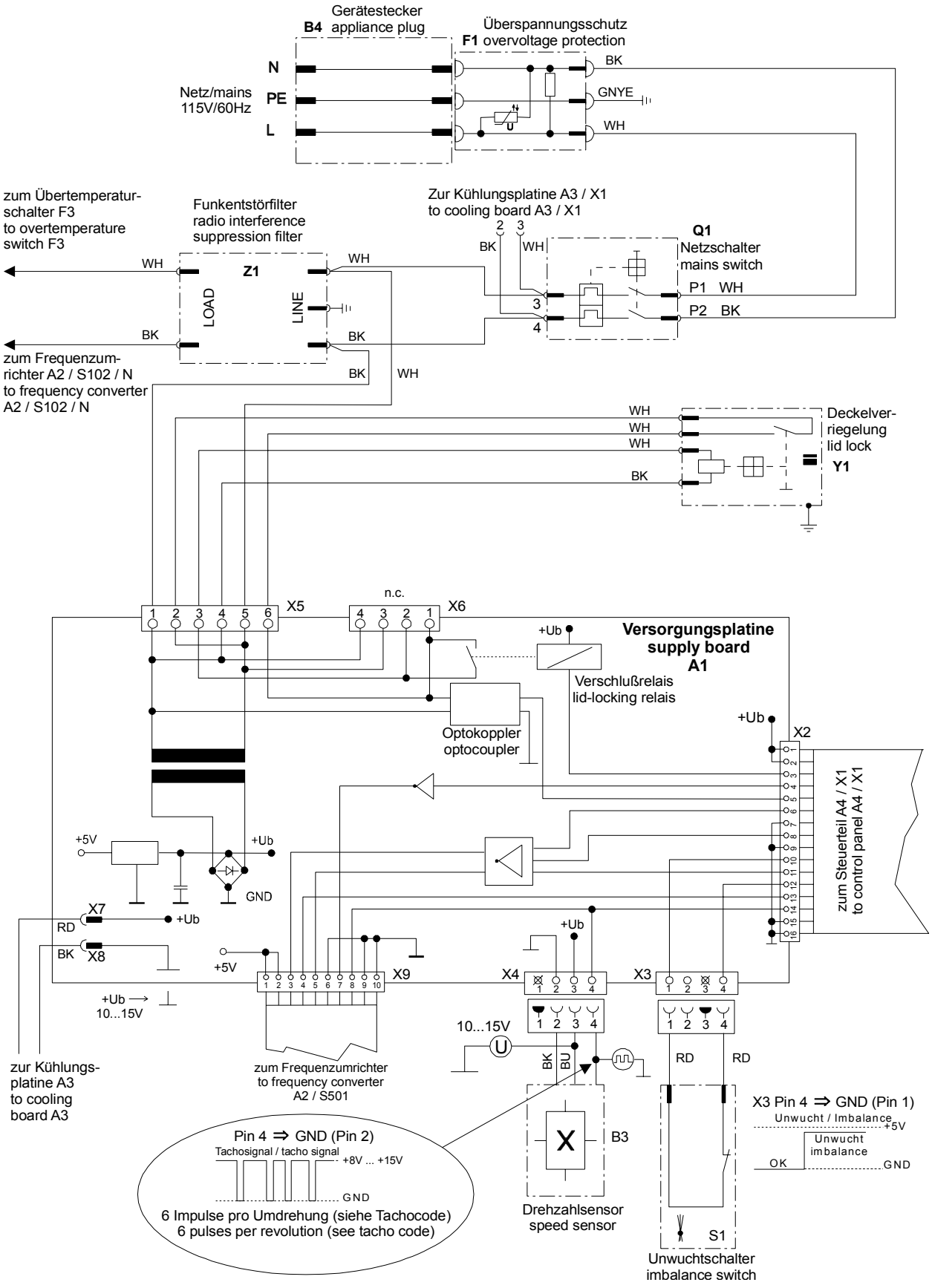
colour	short code
black	BK
brown	BN
red	RD
orange	OG
yellow	YE
blue	BU
violet	VT
green	GN
grey	GY
white	WH
pink	PK
gold	GD
silver	SR
green-yellow	GNYE

11. Circuit diagrams

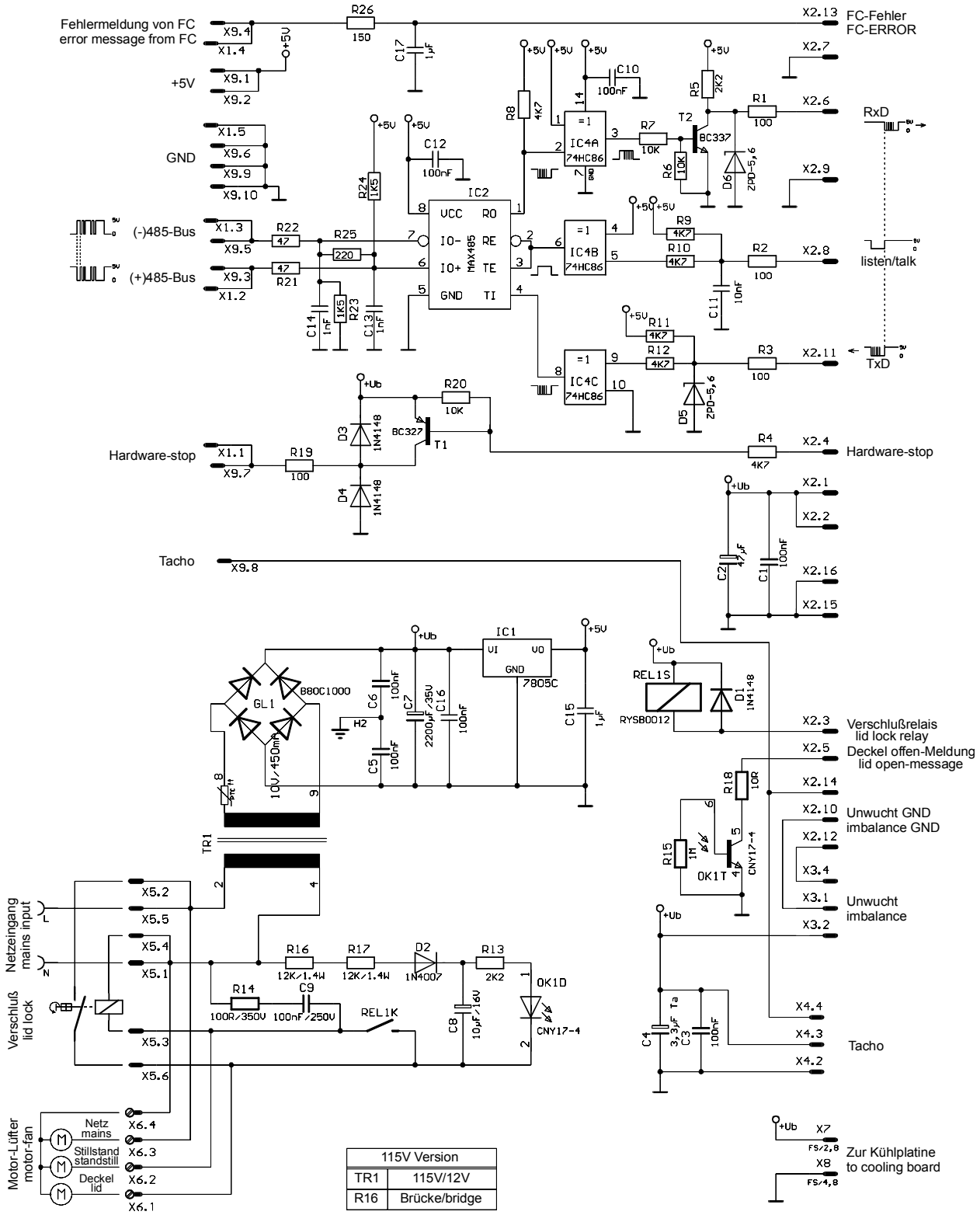
11.1. Mains supply with supply board (SB) 230 V



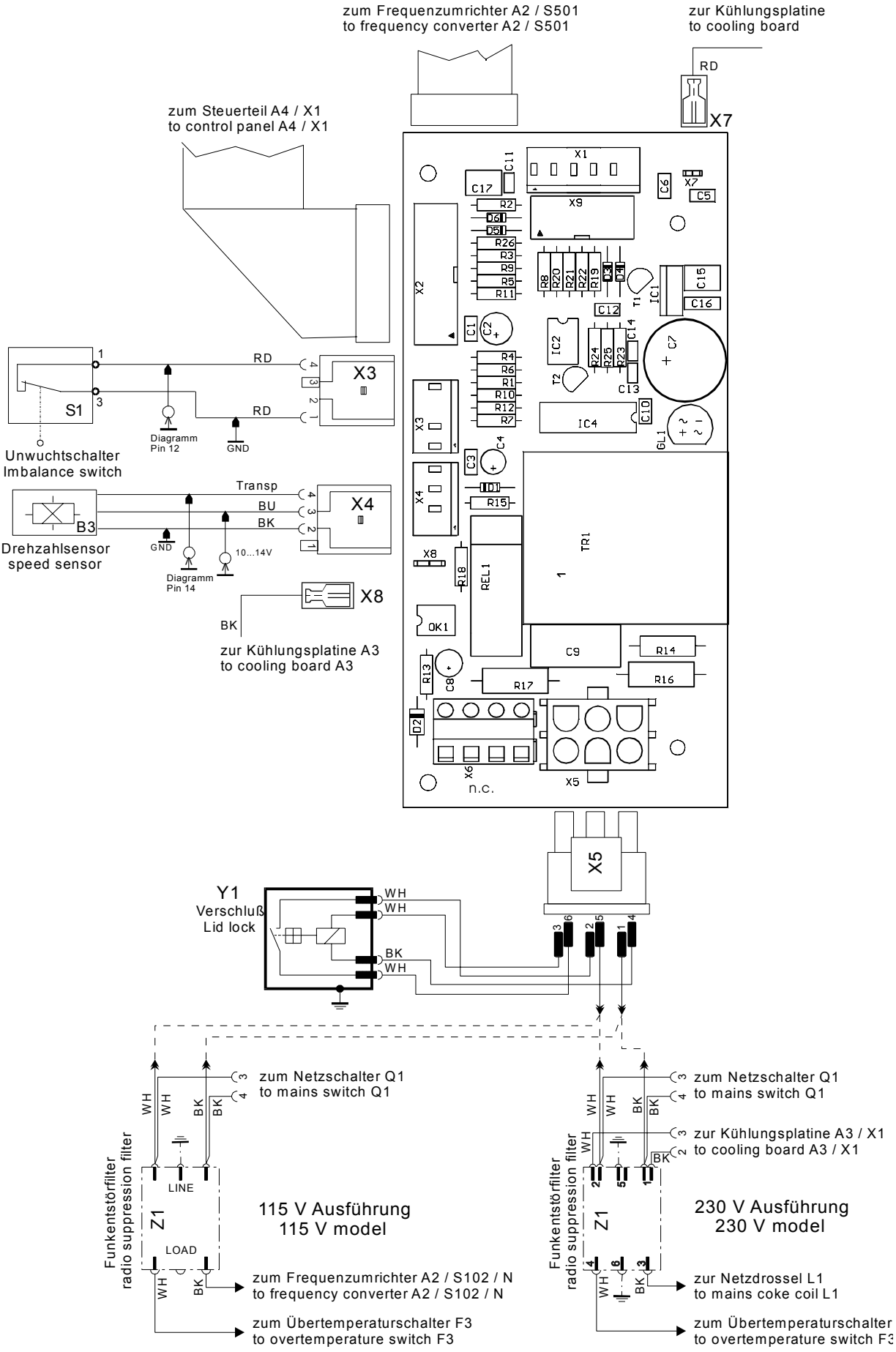
11.2. Mains supply with supply board (SB) 115 V



11.3. Circuit diagram supply board (SB)

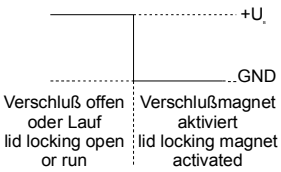


11.4. Connecting diagram and component layout supply board (SB)

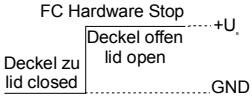


11.5. Signals at control cable (between CP-SB)

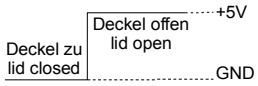
X1 Pin 3 ⇒ GND

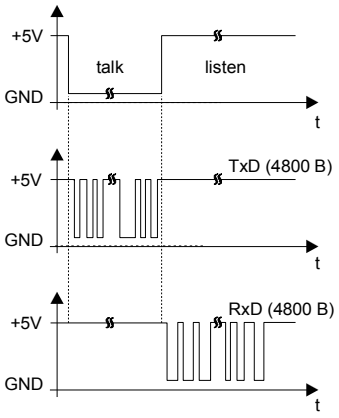


X1 Pin 4 ⇒ GND



X1 Pin 5 ⇒ GND





X1 Pin 8 ⇒ GND
ser. Schnittstelle vom CP
ser. interface from CP

X1 Pin 11 ⇒ GND
ser. Schnittstelle vom CP
ser. interface from CP

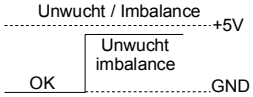
X1 Pin 6 ⇒ GND
ser. Schnittstelle zum CP
ser. interface to CP

X1 Pin 7 ⇒ GND : 0V

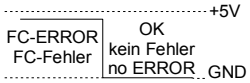
X1 Pin 9 ⇒ GND : 0V

X1 Pin 10 ⇒ GND : 0V

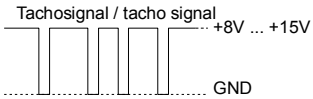
X1 Pin 12 ⇒ GND



X1 Pin 13 ⇒ GND



X1 Pin 14 ⇒ GND



6 Impulse pro Umdrehung
siehe Tachocode
6 pulses per revolution
see tachocode

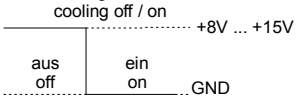
nur bei Zentrifuge mit Kühlung
only centrifuge with cooling

X101 Pin 8 ⇒ GND

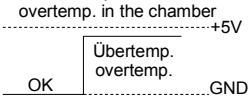
Spannung vom Temperaturfühler
voltage from temperature sensor

25°C = 2.98V
Unterschied / difference 1°K = 10mV

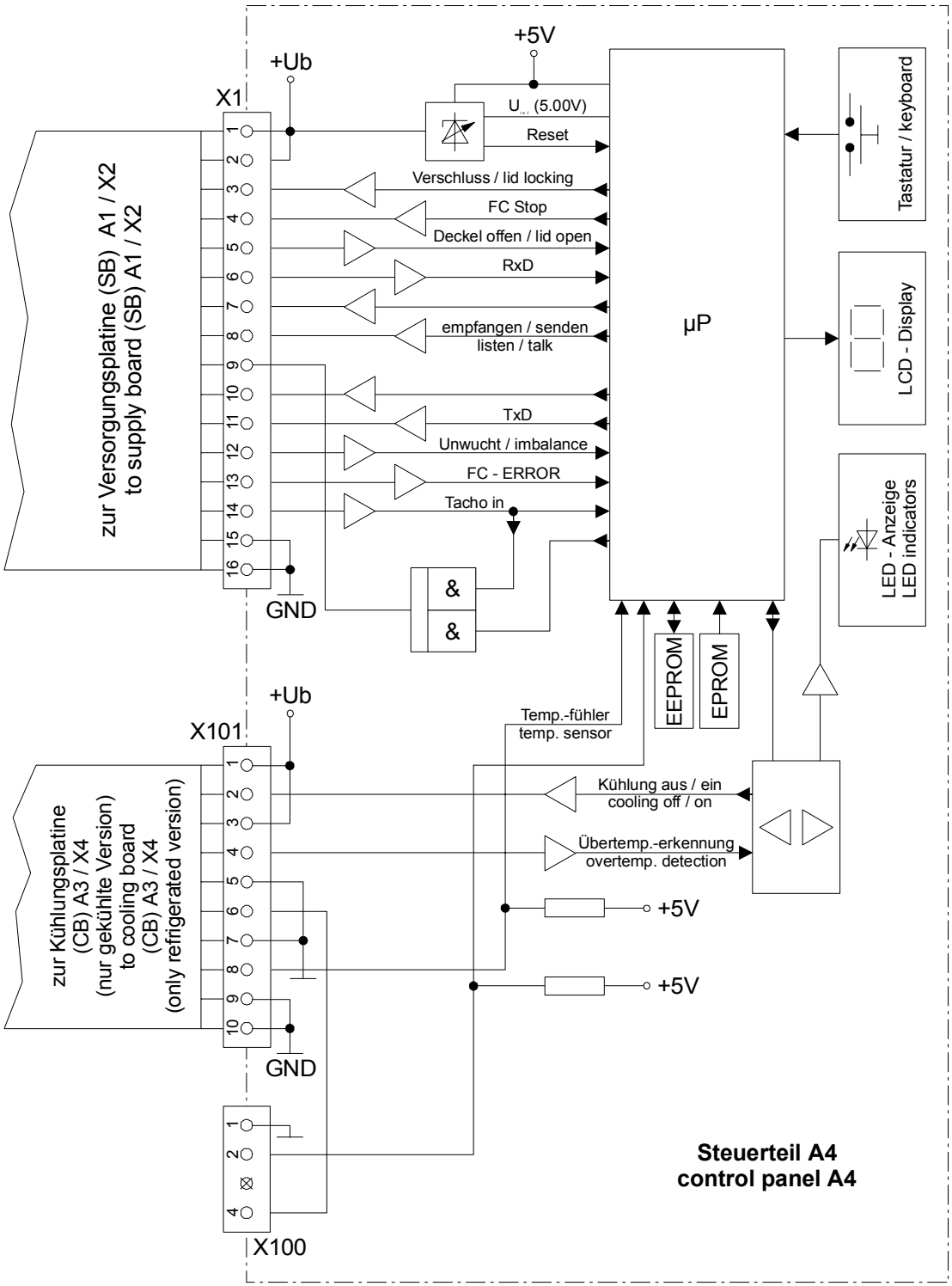
X101 Pin 2 ⇒ GND



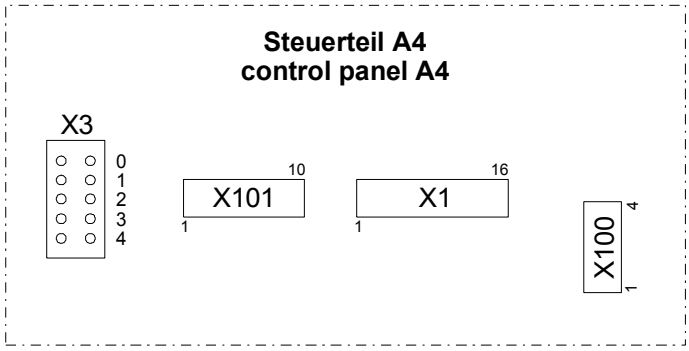
X101 Pin 4 ⇒ GND

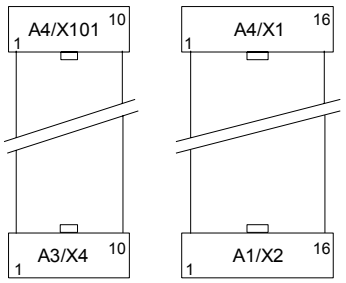


11.6. Block diagram control panel (CP)



11.7. Connecting diagram Control board (CP)

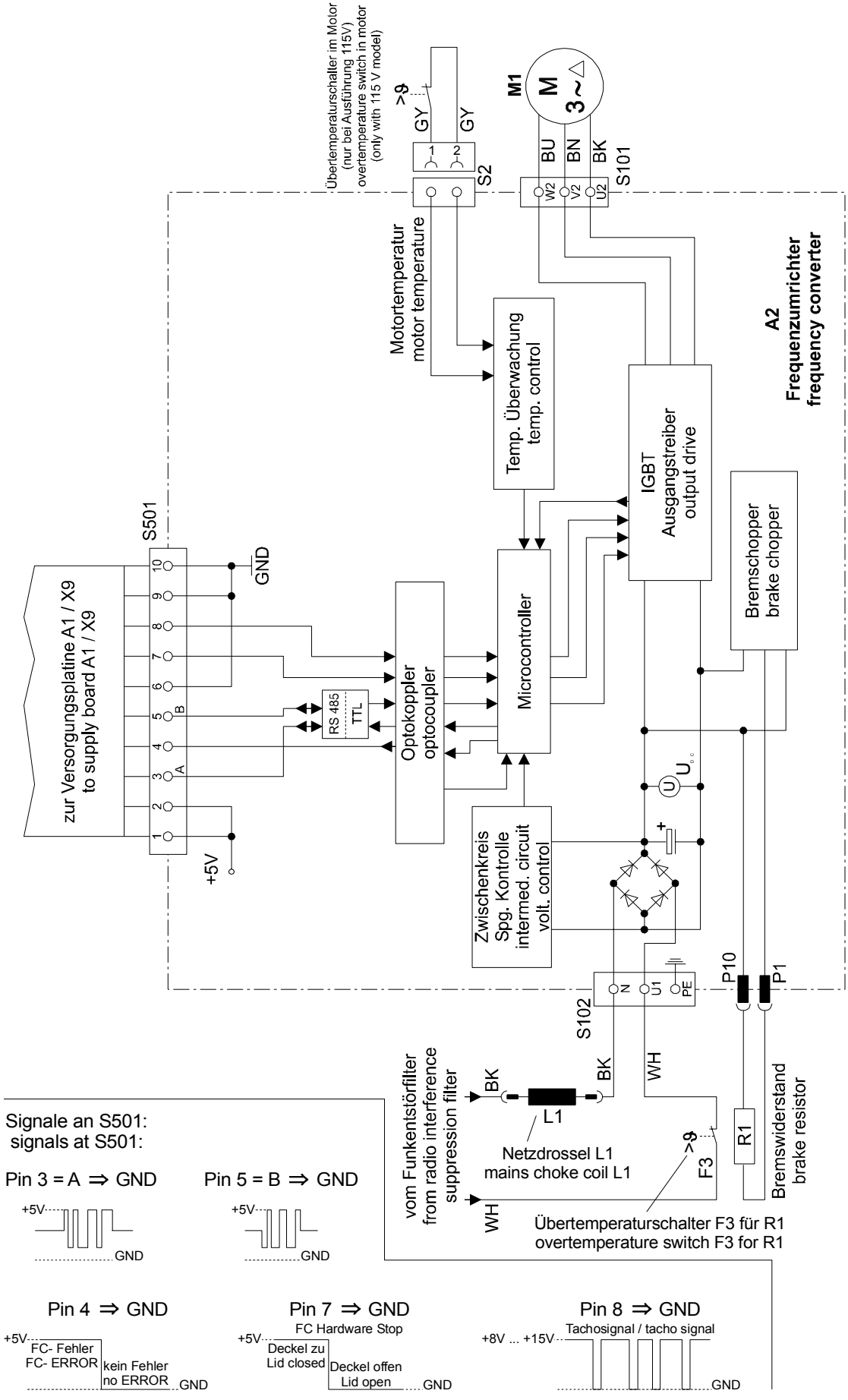




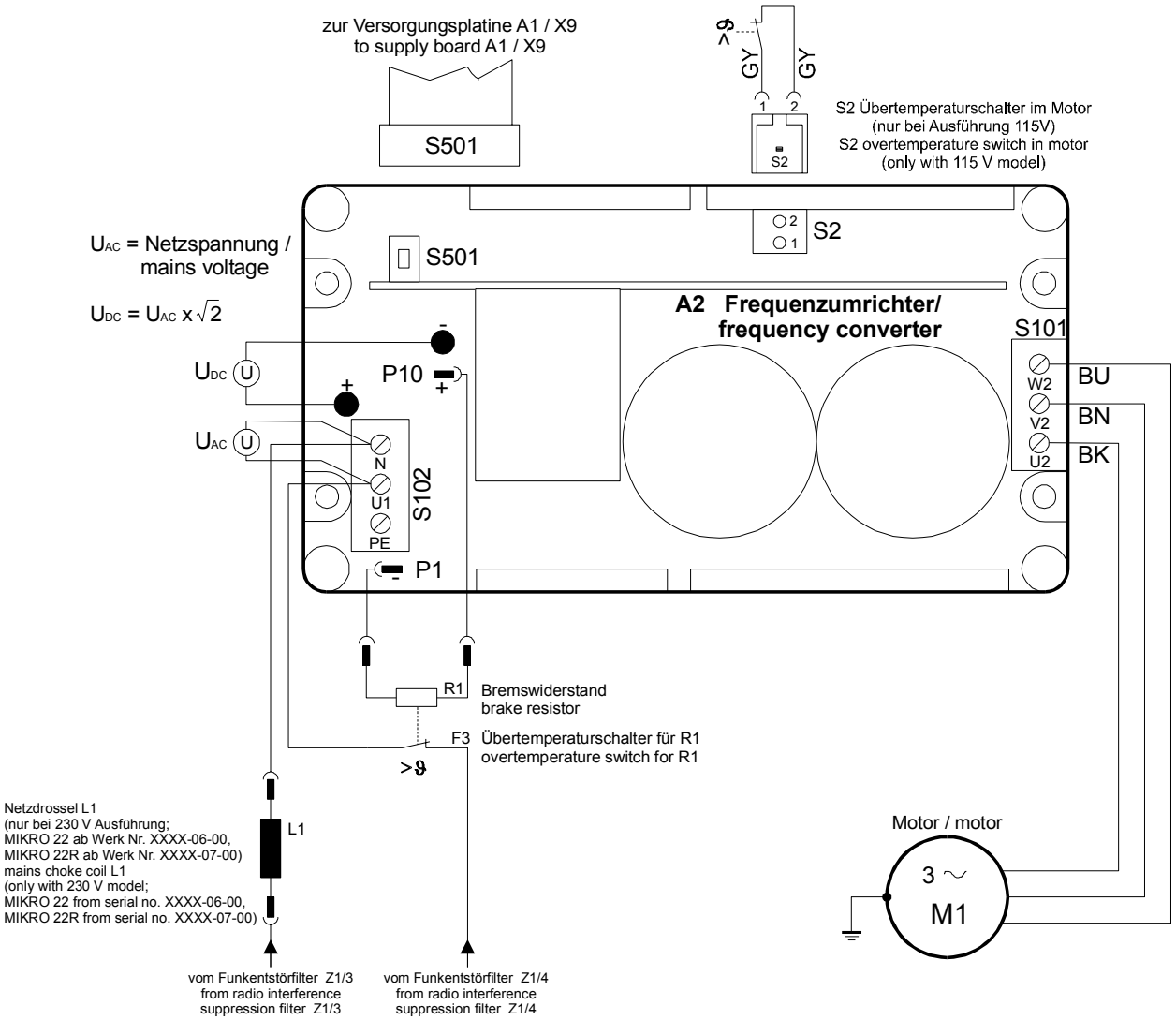
zur Kühlungspaltine
nur gekühlte Version
to cooling board
only refigerated Version

zur Versorgungsplatine
to supply board

11.8. Block diagram and signals at frequency converter (FC)



11.9. Connecting diagram frequency converter (FC)

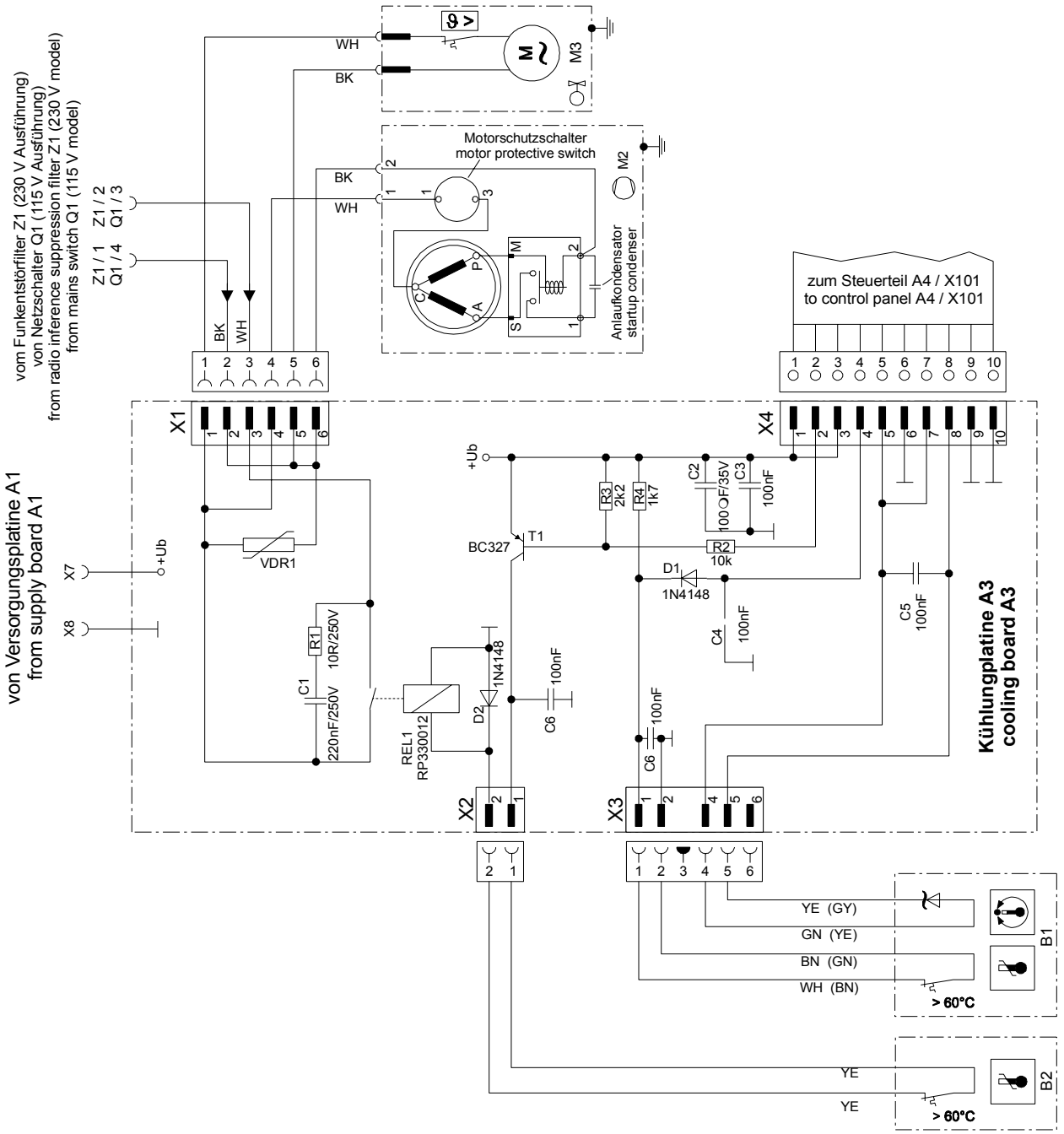


Bremswiderstand	230 V Ausführung:	160 Ω
Brake resistor	115 V Version:	70 Ω

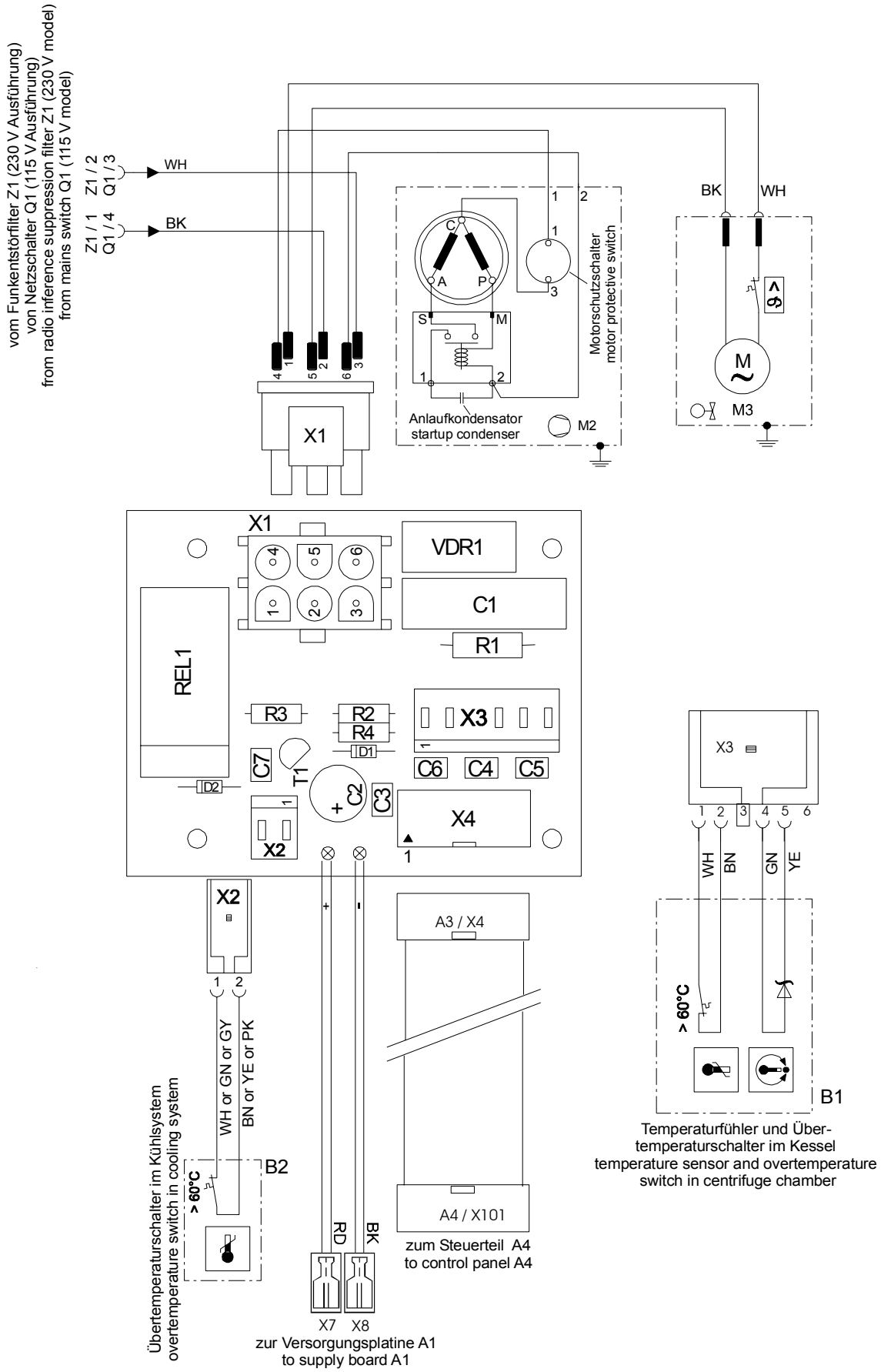
Motorwiderstand (kalter Motor, zwischen je 2 Leitungen)
Motor resistance value (cold motor, between 2 wires)

230 V Ausführung:	1,5 Ω
115 V Version:	

11.10. Circuit diagram cooling board



11.11. Connecting diagram and component layout cooling board



12. Technical specifications

Manufacturer	Hettich Zentrifugen D-78532 Tuttlingen			
Model	MIKRO 22		MIKRO 22 R	
Product No.	1105	1105-01	1110	1110-01
Mains voltage (± 10%)	220-240 V 1~	110-127 V 1~	220-240 V 1~	110-127 V 1~
Mains frequency	50-60 Hz	50-60 Hz	50–60 Hz	60 Hz
Connected load	700 VA	650 VA	900 VA	900 VA
Current consumption	3.1 A	6.0 A	3.7 A	7.5 A
Power consumption	450 W	450 W	650 W	750 W
Refrigerant	-----		R 404A	
Max. capacity	60 x 2,2 ml		6 x 50 ml	
Max. density	1.2 kg/dm^3			
Speed RPM	18000			
Force RCF	31880			
Kinetic energy	9900 Nm			
Obligatory inspection	no			
Environment – Ambient temperature – Relative humidity	5°C up to 40°C max. 80% up to 31°C, descending in a linear pattern down to 50% at 40°C			
Sample overtemp.	≤ 15 K		-----	
Class of protection	I			
EMC	ISM (Industrial Science Medicine)			
– Emission (Radio interference suppression)	EN 55011 Class B	FCC Class B	EN 55011 Class B	FCC Class B
– Immunity	according to EN 50082-2			
Noise level (dependent on rotor)	58 - 62 dB(A)		57 - 64 dB(A)	
Dimensions				
• Width	333 mm		333 mm	
• Depth	390 mm		620 mm	
• Height	278 mm		278 mm	
Weight ca.	16.3 kg		36.3 kg	